(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 361 589 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.11.2003 Bulletin 2003/46

(51) Int Cl.[7]: **H01H 3/12**

(21) Application number: **03018403.0**

(22) Date of filing: **07.03.2002**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
02005144.7 / 1 343 182

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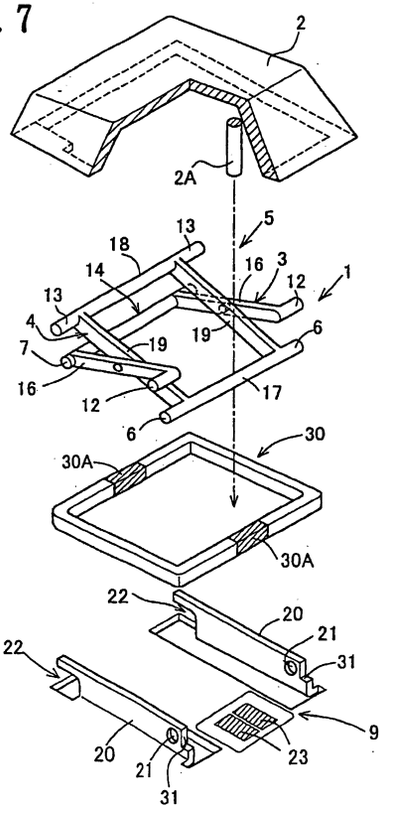
Remarks:
This application was filed on 13 - 08 - 2003 as a divisional application to the application mentioned under INID code 62.

(54) Keyswitch device, keyboard with the keyswitch device, and electronic apparatus with the keyboard

(57) A key top is urged upward via a rubber elastic member stretched between a first link member and a second link member with ends of shaft members provided to both side portions of a shaft of the first link member and shaft members provided to both side portions of a shaft of the second link member supported in insertion holes in thick portions of each rubber elastic member in one embodiment. Alternative embodiments use a ring or retangular type rubber elastic member that encloses a base position of the first and second link members.

FIG. 7



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Description

BACKGROUND OF THE INVENTION

1. Field of Invention

[0001] The invention relates to a keyswitch device wherein a key top can be operated with excellent operability and a keyboard including the keyswitch device or electronic equipment including the keyboard, such as a notebook computer and a word processor.

2. Description of Related Art

[0002] Conventionally, various types of keyswitch devices for keyboards installed in notebook personal computers, word processors, and the like, have been on the market. The keyswitch devices are inevitably required to be low-profile and be miniaturized in keeping with developments in the field, such as a reduction in the thickness and size of the notebook personal computers. A sufficient key stroke is also required in terms of key operability.

[0003] In order to achieve such requirements, the conventional keyswitch device is generally structured such that up-and-down movements of a key top are guided via a guide support member including a pair of link members. Further, a rubber spring, such as an upside-down cup, is positioned between the link members under the key top. In the keyswitch device, a switching operation is performed by which a membrane switch, disposed under the rubber spring, is operated by pressing and buckling the rubber spring disposed under the key top in accordance with the pressing of the key top, or by a moving contact, fixedly attached to an upper wall within the rubber spring, which is short-circuited against a fixed contact formed on a circuit board.

[0004] However, the conventional keyswitch device essentially needs a rubber spring as an elastic member for urging the key top upward and mediating the switching operation. Currently, keyswitch devices having various types of rubber springs are commercially available. However, when the rubber spring is used, the reduction of the thickness and size of the keyswitch device is inevitably restricted limiting the reduction of key pitches or design of key strokes.

[0005] In order to solve the problem above, Japanese Laid-Open Patent Publication No. 10-172380 discloses a keyswitch device wherein up-and-down movements of a key top are guided by a link mechanism. The link mechanism includes a pair of link members disposed between the key top and a base mold provided on a membrane sheet while an elastic member, made of a rubber sheet, is laid across the link members so as to cross over a middle portion of the keyswitch device under the link members.

[0006] In the keyswitch device, when the key top is not depressed, a circular protrusion formed on a lower surface of the key top is urged upward via the elastic member to be held at a non-depressed position. When the key top is being depressed, the circular protrusion is pressed against an urging force from the elastic member, so that the switching operation is performed by operating a switch portion of the membrane sheet via a protrusion formed on the lower surface of the elastic member.

[0007] In the keyswitch device disclosed in Japanese Laid-Open Patent Publication No. 10-172380, a rubber spring is not used. Accordingly, the keyswitch device can be freely designed to provide a reduction in the thickness and size of the keyswitch device and without restricting reduction of the key pitches or the design of the key stroke.

[0008] However, in the keyswitch device disclosed in Japanese Laid-Open Patent Publication No. 10-172380, an elastic member made of a rubber sheet is laid across a pair of link members under them, and the elastic member is disposed so as to cross over the middle portion of the keyswitch device. As a result, the space provided under the key top can not be efficiently used because of the existence of the elastic member. Accordingly, for example, it becomes basically impossible to dispose electronic components, such as LEDs, under the key top.

SUMMARY OF THE INVENTION

[0009] The invention provides a keyswitch device in which a space is provided under a key top so that various types of electronic components, such as LEDs, can be disposed therein. This is permitted by positioning an urging member for urging the key top upward on the sides of end portions of link members such that a key top achieves excellent operability.

[0010] In order to achieve this, the keyswitch device according to the invention includes a key top provided with a plurality of upper engaging portions at its lower surface, a support plate that is disposed beneath the key top and provided with a plurality of lower engaging portions, a guide support member that includes a pair of link members engaged by the upper engaging portions at an upper end portion and by the lower engaging portion at a lower end portion and that guides and supports up-and-down movements of the key top, an urging member that includes an elastic member stretched between a side portion of the lower end portion of the one link member and a side portion of the lower end portion of the other link member or is stretched between the side portion of the upper end portion of the one link member and the side portion of the upper end portion of the other link member and that urges the key top upward to hold the key top at a non-depressed position, and a switching member that performs a switching operation in accordance with a pressing of the key top.

[0011] In the keyswitch device of the invention, as an urging member for urging the key top upward, a rubber

elastic member is used. The rubber elastic member is stretched between the side portion of the lower end portion of the one link member and the side portion of the lower end portion of the other link member or is stretched between the side portion of the upper end portion of the one link member and the side portion of the upper end portion of the other link member. Therefore, the urging member can be disposed on the outer side of each link member. Accordingly, the urging member does not effect the space provided under the key top, so that the space can be effectively used. Thus, for example, an electronic component can be disposed under the key top, so that the keyswitch device of the invention can have multi-functions, and also can be reduced in its thickness and size.

[0012] Another keyswitch device according to the invention includes a key top provided with a plurality of upper engaging portions at its lower surface, a support plate that is disposed beneath the key top and is provided with a plurality of lower engaging portions, a guide support member that includes a pair of link members engaged by the upper engaging portions at an upper end portion and by the lower engaging portion at a lower end portion and that guides and supports up-and-down movements of the key top, an urging member that includes an annular elastic member disposed to surround the lower end portion of each link member or to surround the upper end portion of each link member and contacts at least one of the link members to apply an urging force and that urges the key top upward to hold the key top at a non-depressed position, and a switching member that performs a switching operation in accordance with a pressing of the key top.

[0013] An annular rubber elastic member is used, in the keyswitch device structured as described above, as an urging member for urging the key top upward. The annular rubber elastic member surrounds and contacts a lower end portion or an upper end portion of the pair of link members constituting the guide support member of the key top and exerts an urging force on the pair of link members. Accordingly, the urging member has no effect on the space provided under the key top, so that the space can be effectively used. Thus, for example, an electronic component, such as an LED component, can be disposed under the key top, so that the keyswitch device of the invention can have multi-functions, and also can be reduced in thickness and size.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Embodiments of the invention will be described in detail with reference to the following figures wherein:

FIG. 1A is a perspective view of a notebook type personal computer;

FIG. 1B is a block diagram electrically showing a structure of the notebook type personal computer;

FIG. 2 is a disassembled perspective view of a keyswitch device according to a first embodiment;

FIG. 3 is a cutaway perspective view showing the keyswitch device according to the first embodiment;

FIGS. 4A, 4B and 4C are schematic sectional views showing states of the keyswitch device from when a key top is not depressed to when the key top is pressed to a position where a switching operation is performed;

FIGS. 5A and 5B are exemplary diagrams showing examples of rubber elastic members;

FIG. 6 is a schematic sectional view of an LED portion;

FIG. 7 is a disassembled perspective view of a keyswitch device according to a second embodiment;

FIG. 8 is an exemplary diagram showing an example of an annular rubber elastic member;

FIGS. 9A and 9B are sectional views showing states of the keyswitch device from when a key top is not depressed to when the key top is pressed to a position where a switching operation is performed;

FIG. 10 is a disassembled perspective view of a keyswitch device according to a third embodiment;

FIG. 11 is an exemplary diagram schematically showing a mechanism for sliding a slide plate;

FIG. 12A is a schematic sectional view of the keyswitch device in an operable state;

FIG. 12B is a schematic sectional view of the keyswitch device in an unused state;

FIGS. 13A and 13B are schematic sectional views showing states of the keyswitch device from when a key top is not depressed to when the key top is pressed to a position where a switching operation is performed; and

FIG. 14 is an exemplary diagram schematically showing another example of a mechanism for sliding the slide plate.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] A keyswitch device according to the invention will be described based on embodiments of the invention with reference to the accompanying drawings. First, a notebook type personal computer to which a keyswitch device according to the invention is installed will be described with reference to FIGS. 1A and 1B. FIG. 1A is a perspective view of the notebook type personal computer. FIG. 1B is a block diagram showing an electronic structure of the notebook type personal computer.

[0016] In FIG. 1A, the notebook type personal computer 100 basically includes a main unit 102 in which a CPU 101, for performing various operations, is installed, and a cover 111 which is supported so that it can cover and uncover the main unit 102. The cover 111 is provided with a display 103 in its inner surface, and is rotatably supported by a connecting portion 104 of the main unit

102, so that the cover 111 can cover and uncover the main unit 102. The main unit 102 is provided with a keyboard 105 on which a plurality of keyswitch devices 1 are disposed.

[0017] As shown in FIG. 1B, the CPU 101 is connected with a ROM 106 containing programs for controlling each part of the personal computer 100, and a RAM 107 for storing various kinds of data, via a bus 108. The CPU 101 is also connected with an input/output interface 109 via the bus 108. The input/output interface 109 is connected with the display 103, the keyboard 105, and a hard disk device 110 that stores a document preparation program, a spreadsheet program, and the like. The CPU 101 reads the programs from the hard disk device 110, executes the programs, and displays characters and symbols on the display 103, based on input data from the keyboard 105.

[0018] A schematic structure of a keyswitch device, according to a first embodiment, that is installed in the keyboard 105 of the notebook type personal computer 100 will be described with reference to FIGS. 2 and 3. FIG. 2 is a disassembled perspective view of the keyswitch device according to the first embodiment. FIG. 3 is a cutaway perspective view of the keyswitch device according to the first embodiment.

[0019] In FIGS. 2 and 3, the keyswitch device 1 basically includes a key top 2, a guide support member 5 that includes a pair made up of a first link member 3 and a second link member 4 and that guides up-and-down movements of the key top 2, rubber elastic members 8, 8, and a support plate 9 that supports the whole of the keyswitch device 1. The rubber elastic members 8, 8 are urging members, each of which is stretched between ends of a shaft member 7 formed on both side portions of a lower end portion of the first link member 3 and a shaft member 6 formed on both side portions of a lower end portion of the second link member 4.

[0020] The key top 2 is formed of ABS resin or the like, and characters, symbols, etc. are printed on the upper surface of the key top 2. On the underside of the key top 2, two pivot-holding portions 10, 10 and two slide-holding portions 11, 11 are integrally formed with the key top 2, corresponding to the first link member 3 and the second link member 4, respectively. A holding groove 10A is provided in each pivot-holding portion 10, 10, and a slide groove 11A is provided in each slide-holding portion 11,11. The holding grooves 10A, 10A of the pivot-holding portions 10, 10 rotatably catch shaft members 12, 12 formed on the ends of the upper end of the first link member 3. The sliding grooves 11A, 11A of the slid-holding portions 11, 11 slidably catch shaft members 13, 13 formed on the ends of the upper end of the second link member 4. A pressing protrusion 2A is formed on a side portion (a left-handed side in FIGS. 2 and 3) of the underside of the key top 2 at a substantially middle portion in a longitudinal direction of the key top 2. The pressing protrusion 2A presses and elastically deforms a conductive portion 8C provided to the rubber elastic member 8 directly below, described later.

[0021] The guide support member 5 is structured by combining the first link member 3 and the second link member 4. The first link member 3 has a unitary structure such that a shaft 14, including the shaft members 7, 7 to form a single substantially continuous shaft, and a shaft 15, including the shaft members 12, 12 to form a substantially continuous shaft, are connected by two connecting members 16, 16. The first link member 3 has a substantially rectangular shape in plan view.

Formed at the middle portion of each connecting member 16 is a support shaft. The second link member 4 has the same basic structure as the first link member 3. The second link member 4 has a unitary structure such that a shaft 17, including the shaft members 6, 6 forms a substantially continuous shaft, and a shaft 18, including the shaft members 13, 13 forms a substantially continuous shaft, are connected by two connecting members 19, 19. The second link member 4 has a substantially rectangular shape in plan view. Each connecting member 19, has an insertion hole into which a support shaft formed on an opposing connecting member 16 of the first link member 3 is inserted to form the guide support member 5 having a scissors-type linkage.

[0022] The structure of the guide support member 5 assembled from the first link member 3 and the second link member 4 is known in the art. Therefore, a more detailed explanation concerning the structure of the guide support member 5 will be omitted.

[0023] Disposed below the guide support member 5 is the support plate 9. The support plate 9 is a thin plate made of metal or a resin. The support plate 9 is integrally provided with two bent/extending pieces 20, 20 corresponding to the keyswitch device 1 by, in the case of a metal plate, cutting and vertically bending the support plate 9. The support plate 9 is incised in a substantially C-shape in two places to form two cut pieces. Then, the pieces are upwardly bent, thereby forming the bent/extending pieces 20, 20. For a resin plate, the bent/extending pieces 20, 20 would normally be molded although a cutting and shaping process can also be used.

[0024] Both the bent/extending, pieces 20, 20 have the same structure. Each bent/extending piece 20 is formed with a pivot hole 21 and a slide hole 22. The shaft members 6, 6 of the second link member 4 are pivotally retained by the respective pivot holes 21, 21. The shaft members 7, 7 of the first link member 3 are slidably retained by the respective slide holes 22, 22.

[0025] Printed on the support plate 9, is a pair of fixed electrodes 23, 23 for performing switching. A predetermined circuit pattern (not shown), connected to each fixed electrode 23, is printed adjacent to one of the bent/extending pieces 20, 20 (provided on the left-handed side in FIG. 2) by a conductive coating. The fixed electrodes 23, 23 and the circuit pattern are printed after an insulation coating is formed on the upper surface of the support plate 9, by applying an insulation material. Then, the fixed electrodes 23, 23 and the circuit pattern

are printed using a conductive coating.

[0026] As shown in FIG. 3, the shaft members 6, 6 of the second link member 4 and the shaft members 7,7 of the first link member 3 are retained by the respective pivot holes 21, 21 and slide holes 22, 22 formed in the bent/extending pieces 20, 20. A rubber elastic member 8, made of silicon rubber, is stretched between the end of the shaft member 6, that protrudes outwardly from the pivot hole 21, and the end of the shaft member 7, that protrudes outwardly from the slide hole 22, on both sides of the guide support member. Because the rubber elastic members 8, 8 are stretched between the protruding ends of the shaft members 6, 6 and the protruding ends of the shaft members 7, 7, the rubber elastic members 8, 8 urge the shaft members 6, 6 and 7, 7 in a direction that the shaft members 6, 6 and 7, 7 pull toward each other. In accordance with an elastic force generated by the rubber elastic members 8, 8, the first link member 3 and the second link member 4 are urged in a direction to fold each other. Accordingly, the key top 2 is upwardly urged and thus is held at a non-depressed position.

[0027] Each rubber elastic member 8 is formed with thick portions 8A at positions where the shaft members 6, 6, and 7, 7 are inserted. In each thick portion 8A, an insertion hole 8B is formed into which the shaft members 6, 6, and 7, 7 are inserted. The thick portions 8A prevent the rubber elastic member 8 from being deformed by the surrounding area of the insertion hole 8B when the shaft members 6, 6, and 7, 7 are inserted. At the substantially middle portion of each rubber elastic member 8, a conductive portion 8C is provided. When the key top 2 is depressed, the conductive portion 8C is elastically deformed by being pressed via the pressing protrusion 2A and the conductive portion 8C contacts the fixed electrodes 23, 23 to cause a short-circuit, thereby bringing the fixed electrodes 23, 23 into electrical contact with each other. The conductive portion 8C may be integrally formed with the rubber elastic member 8 with a different color when molding the rubber elastic member 8, or may be formed with a conductive rubber fixedly attached to the rubber elastic member 8 using an adhesive. In this embodiment, the conductive portion 8C is provided to protrude outward of the rubber elastic member 8. However, it is not restricted to the embodiment. For example, as shown in FIG. 5A, the conductive portion 8C may be provided so as to be the same member as the rubber elastic member 8. As shown in FIG. 5B, the conductive member 8 may be provided to the side end portion of the thick portion 8A. In these cases, the pressing protrusion 2A needs to be formed on the underside of the key top 2 to correspond to the position where the conductive portion 8C is formed.

[0028] An LED component 24 is disposed on the support plate 9 between the bent/extending pieces 20, 20. As described above, in the keyswitch device 1 according to the first embodiment, the rubber elastic members 8, 8, urging the first link member 3 and the second link member 4 to the key up position, are provided on both sides of the first link member 3 and the second link member 4, and the first link member 3 and the second link member 4 are formed into a substantially rectangular shape. Therefore, it becomes possible to provide a space under the key top 2. Accordingly, the LED component 24 can be disposed between the bent/extending pieces 20, 20. The LED component 24 lights when a switching operation is performed by pressing the key top 2.

[0029] The general structure of the LED component 24 will be described with reference to FIG. 6. FIG. 6 is a schematic sectional view of the LED component 24. In the LED component 24, as shown in FIG. 6, a molded member 27, molded of a transparent resin to expose a lead 26 of an LED element 25, is fixed to a fixed member 28. The lead 26 and a conductive rubber 29 are brought into conduction by inserting the lead 26 into the conductive rubber 29 which constitutes a wall of the fixed member 28. The lower surface of the conductive rubber 29 abuts against a connecting portion of the circuit pattern formed on the support plate 9. The upper portion of the molded member 27 is made of transparent silicon rubber. Disposed above the molded member 27 is a light diffusing member 241 that diffuses the light generated by the LED.

[0030] The LED component 24 is fixed on the support plate 9 by applying a UV adhesive to the lower surface of the fixed member 28 but not including the lower surface of the conductive rubber 29 and curing the UV adhesive while the lower surface of the conductive rubber 29 is abutted against the connecting portion of the circuit pattern by applying pressure. As a result, the LED component 24 can be firmly fixed on the support plate 9 while the conductive rubber 29, containing the lead 26 of the LED element 25, and the connecting portion of the circuit pattern are electrically connected.

[0031] The operation of the keyswitch device 1 structured as described above will be described with reference to FIGS. 4A, 4B and 4C. FIGS. 4A, 4B and 4C are schematic sectional views showing states of the keyswitch device from when the key top is not depressed (FIG. 4A) to when the key top is slightly pressed (FIG. 4B) to a position where a switching operation is performed (FIG. 4C).

[0032] In FIG. 4A, when the key top 2 is not depressed, the first link member 3 and the second link member 4 are urged in the direction that the shafts of the first link member 3 and the second link member 4 are folded toward each other, that is, in a direction that the key top 2 is lifted, via the two rubber elastic members 8, 8, each of which is stretched between the shaft member 6 of the second link member 4 and the shaft member 7 of the first link member 3. Then, as the key top 2 is gradually depressed, the first link member 3 and the second link member 4 gradually open against the elastic force of the rubber elastic members 8, 8. At that time, the shaft members 6, 6 of the second link member 4 rotate within the respective pivot holes 21, 21 provided

in the bent/extending pieces 20, 20, and the shaft members 13, 13 slide within the respective slide grooves 11A, 11A provided in the slide-holding portions 11, 11 of the key top 2. At the same time, the shaft members 7, 7 of the first link member 3 slide within the respective slide holes 22, 22 provided in the bent/extending pieces 20, 20, and the shaft members 12, 12 rotate within the respective pivot grooves 10A, 10A of the pivot-holding portions 10, 10 of the key top 2. This state is shown in FIG. 4B. The rubber elastic members 8, 8 are slightly extended in this state.

[0033] When the key top 2 is further depressed, the operation described above is successively performed in accordance with the pressing of the key top 2, and the pressing protrusion 2A of the key top 2 presses and elastically deforms the conductive portion 8C of the rubber elastic member 8. As described above, when the pressing protrusion 2A of the key top 2 presses the conductive portion 8C of the rubber elastic member 8, the conductive portion 8C acts as a cushioning material, so that the impact of the pressing protrusion 2A can be absorbed. The rubber elastic member 8 intimately contacts the support plate 9 when the key is depressed, so that operating noise of the key is reduced, as compared with a conventional cap-shaped rubber spring. As described above, when the conductive portion 8C elastically deforms, the conductive portion 8C contacts the fixed electrodes 23, 23 on the support plate 9 to cause a short-circuit, thereby bringing the fixed electrodes 23, 23 into electrical contact with each other. As a result, a predetermined switching operation is performed to light the LED element 25 in the LED component 24. This state is shown in FIG. 4C.

[0034] Upon the release of the pressure on the key top 2, the key top 2 is urged upward due to elastic force from the rubber elastic members 8, 8 and the operation described above is reversed, thereby returning to the non-depressed position.

[0035] As described above, in the keyswitch device 1, according to the first embodiment, the key top 2 is urged upward via two rubber elastic members 8, 8 stretched between the first link member 3 and the second link member 4 with the ends of the shaft members 6, 6 provided to both side portions of the shaft 17 of the second link member 4 and the shaft members 7, 7 provided to both side portions of the shaft 14 of the first link member 3 supported in insertion holes 8B, 8B in thick portions 8A, 8A of each rubber elastic member 8. Therefore, the rubber elastic members 8, 8 can be disposed on the outside of the first link member 3 and the second link member 4 and the rubber elastic members 8, 8 do not affect the space to be provided under the key top 2, so that the space can be effectively used. Accordingly, an electronic component, such as the LED component 24, can be disposed within the space under the key top 2. Thus, the keyswitch device according to the embodiment can have multi-functions and also can be reduced in thickness and size.

[0036] As described above, the conductive portion 8C is provided to the rubber elastic members 8, 8 stretched between the first link member 3 and the second link member 4. When the key top 2 is depressed, the conductive portion 8C of one of the rubber elastic members 8, 8 is elastically deformed via the pressing protrusion 2A formed on the underside of the key top 2 and the fixed electrodes 23, 23 on the support plate 9 are brought into electrical contact via the conductive portion 8C. Therefore, the switching operation can be performed outside the first and second link members 3, 4. Accordingly, the members to perform the switching operation do not affect the space to be provided under the key top 2, so that it becomes easier to effectively use the space.

[0037] As described above, the rubber elastic members 8, 8 are stretched on both sides between the first link member 3 and the second link member 4, so that the key top 2 can be urged upward by the rubber elastic members 8, 8 with the same force from the both sides of the first link member 3 and the second link member 4. Accordingly, the first link member 3 and the second link member 4 are reliably prevented from kinking or jamming, so that the key top 2 can be smoothly depressed. In a case where there is no possibility of the occurrence of kinking or jamming, is not necessary to provide the rubber elastic member 8 on both sides of the first and second link members 3, 4. The rubber elastic member 8 can be provided on only one side.

[0038] A keyswitch device according to a second embodiment, applied to the keyboard 105 of the notebook personal computer 100, will be described with reference to FIG. 7. FIG. 7 is a disassembled, perspective view of the keyswitch device according to the second embodiment. The keyswitch device according to the second embodiment is basically of the same structure as the keyswitch device 1 of the first embodiment. The differences between the keyswitch device 1 of the first embodiment and that of the second embodiment are the rubber elastic member is formed in annular shape and the annular rubber elastic member is disposed so as to surround and contact a lower end of the first and second link members to apply an urging force to the first and second link members. The other structure of the keyswitch device of the second embodiment is the same as the keyswitch device 1 of the first embodiment. In the description below, parts that are same as the parts used for the keyswitch device 1 of the first embodiment have the same reference numerals.

[0039] In FIG. 7, the keyswitch device 1 of the second embodiment basically includes a key top 2, a guide support member 5 that includes a first link member 3 and a second link member 4 to guide the up-and-down movements of the key top 2, an annular rubber elastic member 30, and a support plate 9 that supports the whole of the keyswitch device 1. The annular rubber elastic member 30 is disposed so as to surround and contact a shaft 14 formed at a lower end of the first link member 3 and

a shaft 17 formed at a lower end of the second link member 4 of the guide support member 5 to apply an urging force to them.

[0040] The key top 2 is formed of ABS resin, or the like, and characters, symbols, etc. are printed on the upper surface of the key top 2. On the underside of the key top 2, a pressing protrusion 2A is formed. The pressing protrusion 2A presses and elastically deforms one of conductive portions 30A provided to the rubber elastic member 30 as described later. Other structures of the key top 2 of the second embodiment are the same as that of the first embodiment, so that descriptions of the other structures will be omitted. In FIG. 7, two pivot-holding portions and two slide-holding portions of the keytop 2 are omitted from the illustration.

[0041] The guide support member 5 has the same structure as that of the first embodiment. The guide support member 5 is structured by joining the first link member 3 and the second link member 4. The first link member 3 has a unitary structure such that the shaft 14 having the shaft members 7, 7 forms a substantially continuous shaft and shafts 12 are connected to shaft 14 by two connecting members 16, 16. The first link member 3 has a substantially angular C-shape in plan view. A support shaft is formed at the middle portion of each connecting member 16. The second link member 4 is of basically the same structure as the first link member 3. The second link member 4 has a unitary structure such that a shaft 17, having the shaft members 6, 6 to form a substantially continuous shaft, and a shaft 18, having the shaft members 13, 13 to form a substantially continuous shaft, are connected by two connecting members 19, 19. The second link member 4 has a substantially rectangular shape in plan view. An insertion hole is formed in each connecting member 19. The support shaft formed on each connecting member 16 of the first link member 3 is inserted into a corresponding insertion hole in a connecting member 19 to form a scissors-type linkage.

[0042] The annular rubber elastic member 30 is made of a rubber material, such as a silicon rubber, and is formed into an substantially rectangular shape in plan view. The rubber elastic member 30 is provided with conductive portions 30A in two places, which are symmetric to each other. When the conductive portion 30A is formed in two places, which are symmetric to each other, a restriction on an orientation of the rubber elastic member 30 when the rubber elastic member 30 is mounted in the keyswitch device 1 is reduced. Such simplifies assembly of the keyswitch device. The rubber elastic member 30 is disposed so that one of the conductive portions 30A corresponds to the pressing protrusion 2A of the key top 2. A method for positioning the rubber elastic member 30 will be described later.

[0043] Disposed under the guide support member 5 is the support plate 9, a thin plate made of metal or a resin plate. The support plate 9 is integrally provided with two bent/extending pieces 20, 20 corresponding to the keyswitch device 1 by cutting and vertically bending the support plate 9. The support plate 9 is incised in a substantially C-shape in two places to form two cut pieces. Then, the pieces are upwardly bent, thereby forming the bent/extending pieces 20, 20.

[0044] Both the bent/extending pieces 20, 20 have the same structure. Each bent/extending piece 20 is formed with a pivot hole 21 and a slide hole 22. The shaft members 6, 6 of the second link member 4 are pivotally retained by the pivot holes 21, 21. The shaft members 7, 7 of the first link member 3 are slidably retained by the slide holes 22, 22. Near the pivot hole 21, a stepped portion 31 is formed in each bent/extending piece 20. A part of the rubber elastic member 30 provided with the conductive portions 30A is disposed on the stepped portions 30A, 30A.

[0045] At a substantially middle portion between the bent/extending pieces 20, 20, is a pair of fixed electrodes 23, 23 for performing switching. A predetermined circuit pattern (not shown), connected with each fixed electrode 23, is printed by a conductive coating on the support plate 9. The fixed electrodes 23, 23 and the circuit pattern are printed on an insulation coating after the insulation coating is formed on the upper surface of the support plate 9 by applying an insulation material. Then the fixed electrodes 23, 23 and the circuit pattern are printed by a conductive coating.

[0046] The positioning method of the rubber elastic member 30 will be described below. As described above, the shaft members 6, 6 of the shaft 17 of the second link member 4 are retained by the respective pivot holes 21, 21 formed in the bent/extending pieces 20, 20, and the shaft members 7, 7 of the shaft 14 of the first link member 3 are retained by the respective slide grooves 22, 22 formed in the bent/extending pieces 20, 20. The rubber elastic member 30 is disposed so as to surround and contact the shaft 17 of the second link member 4 and the shaft 14 of the first link member 3 caught by the pivot holes 21 and the slide grooves 22, respectively. More specifically, the rubber elastic member 30 is disposed on the stepped portion 31 of each bent/extending piece 20 so that one of the portions of the rubber elastic member 30 to which the conductive portion 30A (in the right-hand side in FIG. 7) is provided is brought into contact with the shaft 17 of the second link member 4 and another portion provided with the conductive portion 30A (in the left-hand side in FIG. 7) is brought into contact with the shaft 14 of the first link member 3. Other portions, connecting the portions having the conductive portion 30A, are disposed along each bent/extending piece 20. In this state, a conductive portion 30A is disposed over the pair of fixed electrodes 23, 23. The elastic force of the rubber elastic member 30 is exerted on the shaft 14 of the first link member 3. The elastic force of the rubber elastic member 30 urges the first link member 3 and the second link member 4 in the direction to fold toward each other moving the key top 2 to the upper position. Accordingly, the key top 2 is up-

wardly urged and thus is held at a non-depressed position.

[0047] The conductive portion 30A is formed integrally with the rubber elastic member 30 using two different colors when molding the rubber elastic member 30. As shown in FIG. 8, the conductive portions 30A may be formed to protrude outward. In this case, the conductive portion 30A may be formed by fixedly attaching a conductive rubber using adhesives or the rubber elastic member 30 may be formed in one piece. In such a case, the pressing protrusion 2A needs to be formed on the underside of the key top 2 in correspondence with a position where the conductive portion 8C is formed.

[0048] As is the case with the first embodiment, in the keyswitch device I according to the second embodiment, an LED component (not shown in FIG. 7) can be disposed between the bent/extending pieces 20, 20 on the support plate 9. As described above, in the keyswitch device 1 according to the second embodiment, the rubber elastic member 30 urging the first link member 3 and the second link member 4 is disposed around the first link member 3 and the second link member 4, and the first link member 3 is formed into an substantially angular C-shape and the second link member 4 is formed into a substantially rectangular shape. Accordingly, a space can be provided under the key top 2, so that an LED component can be disposed between the bent/extending pieces 20, 20.

[0049] The operation of the keyswitch device 1 structured as described above will be described with reference to FIG. 9. FIGS. 9A and 9B are, schematic sectional views showing states of the keyswitch device from when the key top is not depressed (FIG. 9A) to when the key top is pressed to a position where a switching operation is performed (FIG. 9B).

[0050] In FIG. 9A, when the key top 2 is not depressed, the first link member 3 and the second link member 4 are urged in the direction that the first link member 3 and the second link member 4 are folded toward each other, that is, in a direction that the key top 2 is lifted, via the rubber elastic member 30 disposed on the stepped portions 31 of the bent/extending pieces 20, 20 to contact the shaft 17 of the second link member 4 and the shaft 14 of the first link member 3. At that time, the annular rubber elastic member 30 is supported by the stepped portions 31 provided to the pair of the bent/extending pieces 20, 20 at both sides of the conductive portion 30A, so that the rubber elastic member 30 is held at a position upwardly distance from the fixed electrodes 23, 23 on the support plate 9. Then, as the key top 2 is gradually depressed, the first link member 3 and the second link member 4 gradually open against an elastic force of the rubber elastic member 30. At that time, the shaft members 6, 6 of the second link member 4 are rotated within the respective pivot holes 21, 21 provided in the bent/extending pieces 20, 20, and the shaft members 13, 13 are slid within the respective slide grooves 11A, 11A provided in the slide-holding portions 11 of the key top 2. At the same time, the shaft members 7,7 of the first link member 3 are slid within the respective slide grooves 22, 22 provided in the bent/extending pieces 20, 20, and the shaft members 12, 12 are rotated within the respective pivot grooves 10A, 10A of the pivot-holding portions 10, 10 of the key top 2. At this time, the first and second link members 3,4 extend the rubber elastic member 30 so that the rubber elastic member 30 is in a slightly extended state.

[0051] When the key top 2 is further depressed, the operation described above is successively performed in accordance with the pressing of the key top 2, and the pressing protrusion 2A of the key top 2 presses and elastically deforms the conductive portion 30A of the rubber elastic member 30. As described above, when the pressing protrusion 2A of the key top 2 presses the conductive portion 30A of the rubber elastic member 30, the conductive portion 30A acts as a cushioning material, so that the impact of the pressing protrusion 2A can be absorbed. The rubber elastic member 30 intimately contacts the support plate 9 when the key is depressed, so that operating noise of the key is reduced as compared with the rubber elastic member 8 used in the first embodiment. As described above, when the conductive portion 30A elastically deforms, the conductive portion 30A contacts the fixed electrodes 23, 23 on the support plate 9 to cause a short-circuit, i.e., an electrical connection, thereby bringing the fixed electrodes 23, 23 into electrical conductivity with each other. As a result, a predetermined switching operation is performed. This state is shown in FIG. 9B. The slide grooves 22, 22 of the bent/extending pieces 20, 20 are omitted from the illustration to simplify FIG. 9B. When the pressing of the key top 2 is interfered with by friction produced by contact of the lower surface of the rubber elastic member 30 and the upper surface of the support plate 9, near the slide grooves, a low-frictional coating (slide layer) can be provided in an area of the upper surface of the support plate 9 where the engagement portion of the rubber elastic member 30 and the shaft members 7, 7 move. As an alternative, instead of providing the slide layer, ribs can be provided to protrude from the both ends of the shaft 17 in a direction perpendicular to the shaft 17 and the engagement portion of the rubber elastic member 30 is positioned on the ribs, so that the rubber elastic member 30 does not contact the upper surface of the support plate 9. Upon release of the pressing of the key top 2, the key top 2 is urged upward due to the elastic force from the rubber elastic member 30 and the operation described above is reversed, thereby returning the key top 2 to the non-depressed position.

[0052] As described above, in the keyswitch device 1 according to the second embodiment, the annular rubber elastic member 30 is used as an urging member to urge the key top 2 upward. The rubber elastic member 30 is disposed so that a part of the rubber elastic member 30 is disposed on the stepped portion 31 of each bent/extending piece 20 to contact the shaft 17 of the

second link member 4 while another part of the rubber elastic member 30 contacts the shaft 14 of the first link member 3, whereby the urging member of the rubber elastic member 30 is applied to the first and second link members 3, 4. Therefore, the rubber elastic member 30 can be disposed outside the first and second link members 3, 4 and the rubber elastic member 30 does not affect the space to be provided under the key top 2, so that the space can be effectively used. Accordingly, an electronic component, such as the LED component, can be disposed within the space under the key top 2. Thus, the keyswitch device 1 of the embodiment can have multi-functions, and also can be reduced in thickness and size.

[0053] In the keyswitch device 1 according to the second embodiment, the conductive portions 30A are formed to the annular rubber elastic member 30 disposed outside the first and second link members 3, 4. When the key top 2 is depressed, the conductive portion 30A is elastically deformed via the pressing protrusion 2A formed on the underside of the key top 2 to cause the fixed electrodes 23, 23 on the support plate 9 to be electrically connected and brought into a conduction state. Therefore, the switching operation can be also performed outside the first and second link members 3, 4. Accordingly, the members to perform the switching operation do not affect the space to be provided under the key top 2, so that it is easier to effectively use the space.

[0054] The conductive portion 30A is provided in at least two places, which are symmetrical to each other, in the annular rubber elastic member 30. Therefore, a restriction on an orientation of the rubber elastic member 30 when the rubber elastic member 30 is inserted into the keyswitch device 1 is reduced, so that the keyswitch device 1 can be easily assembled.

[0055] It is to be understood that the invention is not restricted to the particular forms shown in the foregoing embodiments. Various modifications and alterations can be made thereto without departing from the scope of the invention. For example, the rubber elastic member is disposed on the lower end side of the link members in the first and second embodiments. However, the rubber elastic member can be provided on the upper end side of the link members.

[0056] In the embodiments described above, although the pressing protrusion 2A, that presses the conductive portion 8A or 30A when the key top 2 is depressed, is provided on the underside of the key top 2, the pressing protrusion 2A may be provided to the guide support member 5.

[0057] In the embodiments described above, although the guide support member 5 is structured by mutually intersecting the first link member 3 and the second link member 4, it is not a necessary condition, for example, that the first link member 3 and the second link member 4 are crossed. It is essential only that the first link member 3 and the second link member 4 are mutually movably connected.

[0058] In the embodiments described above, the LED component 24 is disposed directly below the key top 2. However, for example, a liquid crystal component that can display a function of the key may be disposed under the key top 2.

[0059] Next, a keyswitch device applied to a keyboard of the notebook type personal computer 100, according to a third embodiment, will be described with reference to FIG. 10. FIG. 10 is a disassembled perspective view of a keyswitch device 1 to be applied to the keyboard device.

[0060] In FIG. 10, as with the second embodiment, the keyswitch device 1 basically includes a key top 2, a guide support member 5 that includes a first link member 3 and a second link member 4 that guide up-and-down movements of the key top 2, an annular rubber elastic member 30, and a support plate 9 that supports the whole of the keyswitch device 1. The annular rubber elastic member 30 is disposed so as to surround and contact a shaft 14 formed at a lower end of the first link member 3 and a shaft 17 formed at a lower end of the second link member 4 of the guide support member 5 to apply an urging force to both link members 3, 4. Descriptions of the same structures of the keyswitch device 1 as found in the second embodiment will be omitted.

[0061] The shaft members 6, 6 of the second link member 4 are rotatably retained by respective pivot holes 21, 21. The shaft members 7, 7 of the first link member 3 are slidably retained by the respective slide grooves 22, 22. Provided between the bent/extending pieces 20, 20, is a plate portion 301 of which one end is connected to the support plate 9 like a cantilever. A substantially C-shaped clearance 32 is provided around the plate portion 301.

[0062] Near a connecting portion of the end of the plate portion 301 and the support plate 9, are a pair of fixed electrodes 23, 23 for performing switching. A predetermined circuit pattern (not shown) is connected with each fixed electrode 23 by a printed conductive coating. The fixed electrodes 23, 23 and the circuit pattern are printed on an insulation coating that is formed on the upper surface of the support plate 9 by applying an insulation material. Disposed substantially at the middle of the plate portion 301 are LED components 24, 24. The LED components 24, 24 light when a switching operation is performed by pressing the key top 2.

[0063] Disposed under the support plate 9, is a slide plate 33. The slide plate 33 can relatively move in a direction of an arrow with respect to the support plate 9. Two engaging pieces 34, 34 are formed at the side end of the slide plate 33 for every keyswitch device 1. As shown in FIG. 10, the engaging pieces 34, 34 are inserted into the clearance 32 existing on a free end side of the plate portion 301. In accordance with the sliding of the slide plate 33, the rubber elastic member 30 is extended and returned to its original state as described below. A sliding mechanism and the sliding operation of

the slide plate 33 will be described later.

[0064] The positioning method for the rubber elastic member 30 is described below. As described above, the shaft members 6, 6 of the shaft 17 of the second link member 4 are caught by the respective pivot holes 21, 21 formed in the bent/extending pieces 20, 20, and the shaft members 7, 7 of the shaft 14 of the first link member 3 are caught by the respective slide grooves 22, 22 formed in the bent/extending pieces 20, 20. The rubber elastic member 30 is disposed so as to surround and contact the shaft 17 of the second link member 4 and the shaft 14 of the first link member 3 retained by the pivot holes 21, 21 and the slide grooves 22, 22, respectively. More specifically, the rubber elastic member 30 is disposed so that one of the portions of the rubber elastic member 30 to which the conductive portion 30A (the right-hand portion in FIG. 10) is engaged with the engaging pieces 34, 34 of the slide plate 33 and another portion provided with the conductive portion 30A (the left-hand portion in FIG. 10) is brought into contact with the shaft 14 of the first link member 3. Other portions connecting the portions having the conductive portion 30A are disposed along each bent/extending piece 20. In this state, the conductive portion 30A (in the left in FIG. 10) is disposed over the pair of fixed electrodes 23, 23. The elastic force of the rubber elastic member 30 is exerted on the shaft 14 of the first link member 3 in a state where the rubber elastic member 30 is engaged with the engaging pieces 34, 34 of the slide plate 33 and is extended. The strength of the elastic force can be changed by adjusting the position of the slide plate 33, so that it can be tailored to operator's liking. The elastic force of the rubber elastic member 30 urges the first link member 3 and the second link member 4 in the direction to fold toward each other. Accordingly, the key top 2 is upwardly urged and thus is held at an operable non-depressed position. When the tension on the rubber elastic member 30 is released by the engaging pieces 34, 34, being moved toward the key center, the rubber elastic member 30 does not produce the urging force, so that the shaft 14 of the first link member 3 is freed from the urging force. At that time, the first link member 3 and the second link member 4 are opened, whereby the key top 2 is held in a lower position where it is lower than the non-depressed position or a storage position.

[0065] The conductive portion 30A is formed integral with the rubber elastic member 30, using two different colors, when molding the rubber elastic member 30. As with the second embodiment, the conductive portions 30A may be formed to protrude outward as shown in FIG. 8.

[0066] As described above, disposed substantially at the middle of the plate portion 31, are the LED components 24. This is made possible by providing a space under the key top 2 as a result of the rubber elastic member 30 urging the first link member 3 and the second link member 4 being disposed around the first link member 3 and the second link member 4, and the first and second link members 3, 4 being formed into a substantially angular C-shape and a substantially rectangular shape, respectively.

[0067] The sliding mechanism of the slide plate 3 will be described with reference to FIG. 11. In FIG. 11, the support plate 9 is provided with key stations S in accordance with the number of keyswitch devices 1 to be disposed on the keyboard device 105. Each key station S includes the pair of bent/extending pieces 20, 20, the plate portion 301, the clearance 32, and the fixed electrodes 23, 23 to constitute the keyswitch device 1.

[0068] In the slide plate 33, the pair of engaging pieces 34, 34 are formed by cutting and bending in correspondence with each key station S. A connecting piece 35 is integrally formed to the side end portion of the slide plate 33 (the upper end portion in FIG. 11). The connecting piece 35 is connected to one end of a link member 36. A rack 37 is fixedly attached to another end of an upper surface of the link member 36. The rack 37 is engaged with a rotary gear 40 fixedly attached to a support shaft 39 that is disposed to the connecting portion 104, of the notebook type personal computer 100, and rotatably supports the cover 111, via an intermediate gear 38.

[0069] A regulation rack 41 (only one regulation rack 41 is shown in FIG. 11) is formed at lower edges of both sides of the slide plate 33. The regulation rack 41 is engaged with respective regulation gears 43 fixed to both ends of a shaft 42 rotatably supported in the main unit 102 of the notebook type personal computer 100. The regulation racks 41 and the regulation gears 43 prevent the slide plate 33 from inclining by engaging each other when the slide plate 33 slides.

[0070] In this structure, the operation for switching between an operation state and a non-operation state of the keyswitch device 1 is associated with the opening and closing of the cover 111 of the notebook type personal computer 100 and will be described with reference to FIGS. 11, 12A and 12B. FIG. 12A is a schematic sectional view of the keyswitch device 1 in an operation state and FIG. 12B is a schematic sectional view of the keyswitch device 1 in a non-operation state. In this latter state, the cover 111 covers the keyboard device 105.

[0071] When the notebook type personal computer 100 is used, the cover 111 is rotated in a direction which the cover 111 uncovers the keyboard device 105. When the cover 111 is rotated in a direction which the cover 111 uncovers the keyboard device 105, the support shaft 39 is rotated in a direction of arrow A. Therefore, the intermediate gear 38 is rotated in a direction of arrow B, so that the rack 37 moves in the direction of arrow C. Accordingly, the slide plate 33 is also slid in a horizontal direction shown by the arrow C via the link member 36 and the connecting piece 35.

[0072] At that time, the engaging pieces 34, 34 of the slide plate 33 engage the rubber elastic member 30 and the rubber elastic member 30 contacts the shaft 14 of the first link member 3. Therefore, when the slide plate 33 is slid in the horizontal direction in accordance with

the rotation of the cover 111 in the opening direction, the engaging pieces 34, 34 slightly extend the rubber elastic member 30. Accordingly, the urging force from the rubber elastic member 30 is exerted on the shaft 14 of the first link member 3. Thus, the first and second link member 3,4 are urged in the direction to fold toward each other in accordance with the urging force from the rubber elastic member 30 because the shaft members 6, 6 of the shaft 17 of the second link member 4 are retained by the pivot holes 21,21 in the bent/extending pieces 20, 20 and are rotated in the pivot holes 21, 21. As a result, the key top 2 is moved upward and held in a non-operation state, i.e., in an operable state of the keyswitch device 1. This state is shown in FIG. 12A.

[0073] The operation of the keyswitch device 1 in the operative state shown in FIG. 12A will be described with reference to FIGS. 13A and 13B. FIGS. 13A and 13B are schematic sectional views showing states of the keyswitch device I from when the key top is not depressed (FIG. 13A) to when the key top is pressed to a position where a switching operation is performed (FIG. 13B).

[0074] In the non-operation state of the key top 2, shown in FIG. 13A, the key top 2 is held at the upper, non-depressed position because the first and second link members 3, 4 are urged in the direction to fold toward each other in accordance with the slight extension of the rubber elastic member 30 by the engaging pieces 34, 34 via movement by the slide plate 30. Then, as the key top 2 is gradually depressed, the first link member 3 and the second link member 4 gradually open against the elastic force from the rubber elastic member 30. At that time, the shaft members 6, 6 of the second link member 4 are rotated within the respective pivot holes 21, 21 provided in bent/extending pieces 20, 20, and the shaft members 13, 13 slide within the respective slide-holding portions of the key top 2. At the same time, the shaft members 7, 7 of the first link member 3 slide within the respective slide grooves 22, 22 provided in the bent/extending pieces 20, 20, and the shaft members 12, 12 are rotated within the respective pivot-holding portions of the key top 2. At this time, the rubber elastic member 30 is further extended by the shaft 14 of the first link member 3.

[0075] When the key top 2 is further depressed, the operation described above is successively performed in accordance with the pressing of the key top 2. The rubber elastic member 30 is extended to the position where the conductive portion 30A of the rubber elastic member 30 reaches the position directly below the pressing protrusion 2A. At that position, the pressing protrusion 2A of the key top 2 presses and elastically deforms the conductive portion 30A of the rubber elastic member 30. As described above, when the pressing protrusion 2A of the key top 2 presses the conductive portion 30A of the rubber elastic member 30, the conductive portion 30A acts as a cushioning material, so that the impact of the pressing protrusion 2A is absorbed. The rubber elastic member 8 intimately contacts the support plate 9 when the key is depressed, so that operating noise of the key is reduced. As described above, when the conductive portion 30A elastically deforms, the conductive portion 30A contacts the fixed electrodes 23, 23 on the support plate 9 to cause a short-circuit, thereby bringing the fixed electrodes 23, 23 into electrical conductivity with each other. As a result, a predetermined switching operation is performed. This state is shown in FIG. 13B.

[0076] Upon release of the pressing of the key top 2, the key top 2 is urged upward due to the elastic force from the rubber elastic member 30 and the operation described above is reversed, thereby returning to the non-depressed position.

[0077] When the cover 111 of the notebook type personal computer 100 is closed, after an input operation using the keyswitch device 1 is completed, the operation described above is performed in reverse. In particular, the support shaft 39 is rotated in a reverse direction of the arrow A. Therefore, the intermediate gear 38 is rotated in a reverse direction of the arrow B, so that the rack moves in a reverse direction of the arrow C. As a result, the slide plate 33 is horizontally slid in a reverse direction of the arrow C via the link member 36 and the connecting piece 35.

[0078] At that time, the engaging pieces 34, 34 of the slide plate 33 are retracted from the rubber elastic member 30, so that the rubber elastic member 30 returns to its original state (a state where the extension is released). Therefore, the urging force of the rubber elastic member 30 is removed so that it does not apply a force to the shaft 14 of the first link member 3. The first link member 3 and the second link member 4 open slightly with respect to each other and, as a result, the key top 2 moves slightly with respect to downward to an unoperable state. This state is shown in FIG. 12B.

[0079] As described above, in the keyboard device 105 according to the third embodiment, the key top 2 is held at the operable non-depressed position by which the slide plate 33 is slid in one direction by rotating the cover 111 of the notebook type personal computer 100 in the open direction and the urging force from the rubber elastic member 30 is applied on the shaft 14 of the first link member 3 in accordance with the engagement of the engaging pieces 34, 34 of the slide plate 3 and the rubber elastic member 30. Further, the key top 2 is held at the lower, basically storage position, which is lower than the non-depressed position of the key top 2. This is achieved by sliding the slide plate 33 in the opposite direction to arrow C by rotating the cover in the direction of covering the main unit 102 and the shaft 14 of the first link member 3 is freed from the urging force from the rubber elastic member 30 by releasing the engagement of the engaging pieces 34, 34 of the slide plate 33 and the rubber elastic member 30. Thus, the urging force from the rubber elastic member 30 urging the key top 2 upward in the plurality of keyswitch devices 1 provided in the keyboard device 105 can be controlled

by the relatively weak strength associated with the opening and closing of the cover 111. Accordingly, a keyboard device 105 that can switch the keyswitch device 1 between the operation state and the non-operation state can be provided.

[0080] As the rubber elastic member 30 has an annular shape, the rubber elastic member 30 can be disposed outside the first and second link members 3, 4. Further, the conductive portions 30A are formed with the annular rubber elastic member 30 and, therefore, disposed outside the first and second link members 3, 4. Thus, when the key top 2 is depressed, the conductive portion 30A is elastically deformed via the pressing protrusion 2A formed on the underside of the key top 2 to cause the fixed electrodes 23, 23 on the support plate 9 to be brought into electrical connectivity. Therefore, the switching operation can be also performed outside the first and second link members 3, 4. Accordingly, the members to perform the switching operation do not affect the space provided under the key top 2, so that the space can be effectively used:

[0081] The conductive portion 30A is provided in at least two places, which are symmetrical with each other in the annular rubber elastic member 30. Therefore, a restriction on an orientation of the rubber elastic member 30 when the rubber elastic member 30 is inserted into the keyswitch device 1 is reduced, so that the keyswitch device 1 can be easily assembled.

[0082] It is to be understood that the invention is not restricted to the particular forms shown in the foregoing embodiments. Various modifications and alterations can be made thereto without departing from the scope of the invention.

[0083] For example, as another mechanism for sliding the slide plate 33, as shown in FIG. 14, an engagement pin 51 is formed on the lower surface of an elongated portion 50 extending from the side edge of the slide plate 33, and the engagement pin 51 is engaged with a cam groove 53 of a cam plate with gear 52. The slide plate 33 slides when the cam plate 52 is rotated via a gear portion 54 of the cam plate 52 in synchronization with the opening and closing of the cover 111. When the cam plate 52 is associated with the opening and closing of the cover 111 of the personal computer 100, the key top 2 is moved to the non-depressed position as the cam plate 52 is rotated by rotating the cover 111 to the open limit. After that, even if the operator rotates the cover 111 to some degree in the closing direction, there is play in the engagement of the engagement pin 51 and the cam groove 53, so that the key top 2 is kept at the non-depressed position.

[0084] The keyboard device 105 is not only used as an input device for personal computers, but also used as a general input terminal. The keyboard device 105 may be provided with a single keyswitch device 1 or a plurality of keyswitch devices 1. As the urging member, instead of using the annular rubber elastic member 30, a sheet-like elastic member or a rod-like elastic member having a predetermined length can be used as shown in FIG. 5a. When the rod-like elastic member is used, an engagement portion is may be provided at both ends of the elastic member for engaging the engaging piece 34 or the shaft member 7.

Claims

1. A keyswitch device (1), comprising:

a key top (2) provided with a plurality of upper engaging portions (10, 11) at its lower surface;
a support plate (9) disposed beneath the key top (2), the support plate (9) provided with a plurality of lower engaging portions (20);
a guide support member (5) comprising a pair of link members (3, 4) that are movably engaged by the upper engaging portions (10, 11) at upper end portion and by the lower engaging portions (20) at lower end portion, the guide support member (5) supporting the key top (2) to guide vertical movement of the key top (2);
an urging member contacting at least one of the link members (3, 4) to apply an urging force in a direction to allow the link members (3, 4) to fold toward each other, the urging member urging the key top (2) upward to hold the key top (2) at a non-depressed position; and
a switching member (23) performing a switching operation in accordance with the vertical movement of the key top (2); **characterized in that**
the urging member includes an annular elastic member (30) disposed to surround the link members (3, 4).

2. The keyswitch device according to claim 1, further comprising:

a pressing protrusion (2A) formed on the lower surface of the key top (2);
a fixed contact portion (23) formed on the support plate (9); and
a conductive portion (30A) provided to the annular elastic member (30);

wherein the conductive portion (30A) and the fixed contact portion (23) are brought into electrical conductivity by elastically deforming the conductive portion (30A) via the pressing protrusion (2A) when the key top (2) is pressed.

3. The keyswitch device according to claim 2, wherein the conductive portion (30A) is provided in at least two places, which are symmetric each other, in the annular elastic member (30).

4. The keyswitch device according to one of claims 1 to 3, wherein the urging member (30) includes at least one of a lower annular elastic member disposed to surround the lower end portion of each link member (3, 4), and an upper annular elastic member disposed to surround the upper end portion of each link member (3, 4).

5. The keyswitch device according to one of claims 1 to 4, wherein the annular elastic member (30) is a rubber elastic member.

6. The keyswitch device according to one of claims 1 to 5, wherein the guide member (5) is structured by mutually intersecting the link members (3, 4), one link member (4) is slidably engaged with the upper engaging portion (11) at an upper end portion and rotatably engaged with the lower engaging portion (20) at a lower end portion, and the other link member (3) is rotatably engaged with the upper engaging portion (10) at an upper end portion and slidably engaged with the lower engaging portion (22) at a lower end portion.

7. A keyboard (105) comprising at least one keyswitch device (1) according to one of claims 1 to 6.

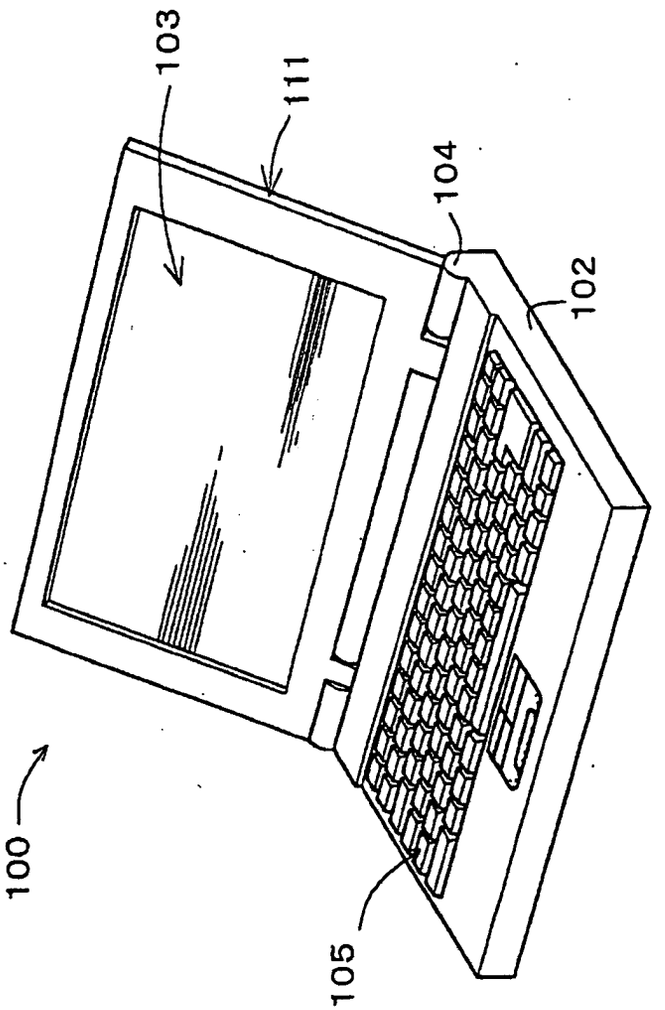
8. The keyboard according to claim 7, wherein the urging member (8, 30) exerts an urging force on the lower end portion of each link member (3, 4), the keyboard (105) further comprising:

a slide plate (33) slidably disposed with respect to the support plate (9), the slide plate (33) provided with an engagement piece (34) engaging the urging member (8, 30); and
a driving device (35-40) holding the key top (2) at a first position by sliding the slide plate (33) in one direction and exerting the urging force from the urging member (8, 30) in accordance with engagement of the engagement piece (34) and the urging member (8, 30), the driving device (35-40) shifting the key top (2) to a second position lower than the first position, by sliding the slide plate (33) in another, opposite direction and releasing the engagement of the engagement piece (34) and the urging member (8, 30) to free the lower end portion of each link member (3, 4) from the urging force of the urging member (8, 30).

9. An electronic device, comprising:

the keyboard (105) according to claim 7 or 8, the keyboard (105) serving for inputting various kinds of data;
a display (103) displaying characters of the input data; and
a controller (101) displaying the characters on the display (103) based on an input from the keyboard (105).

FIG. 1A



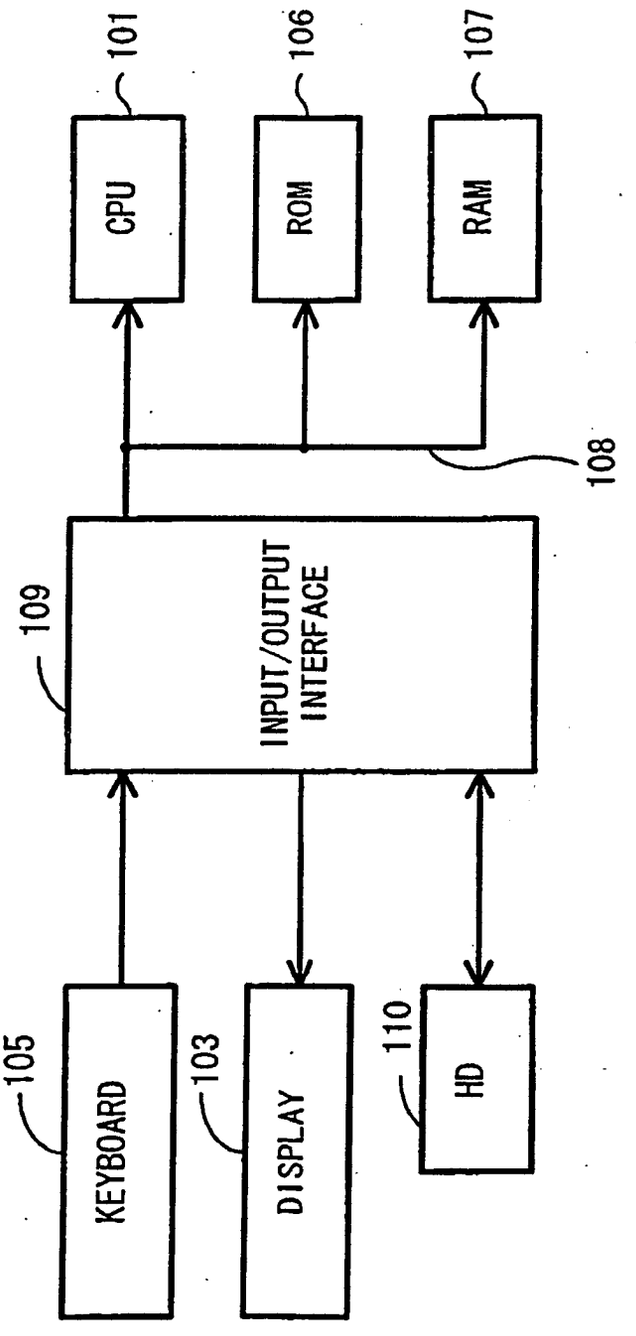
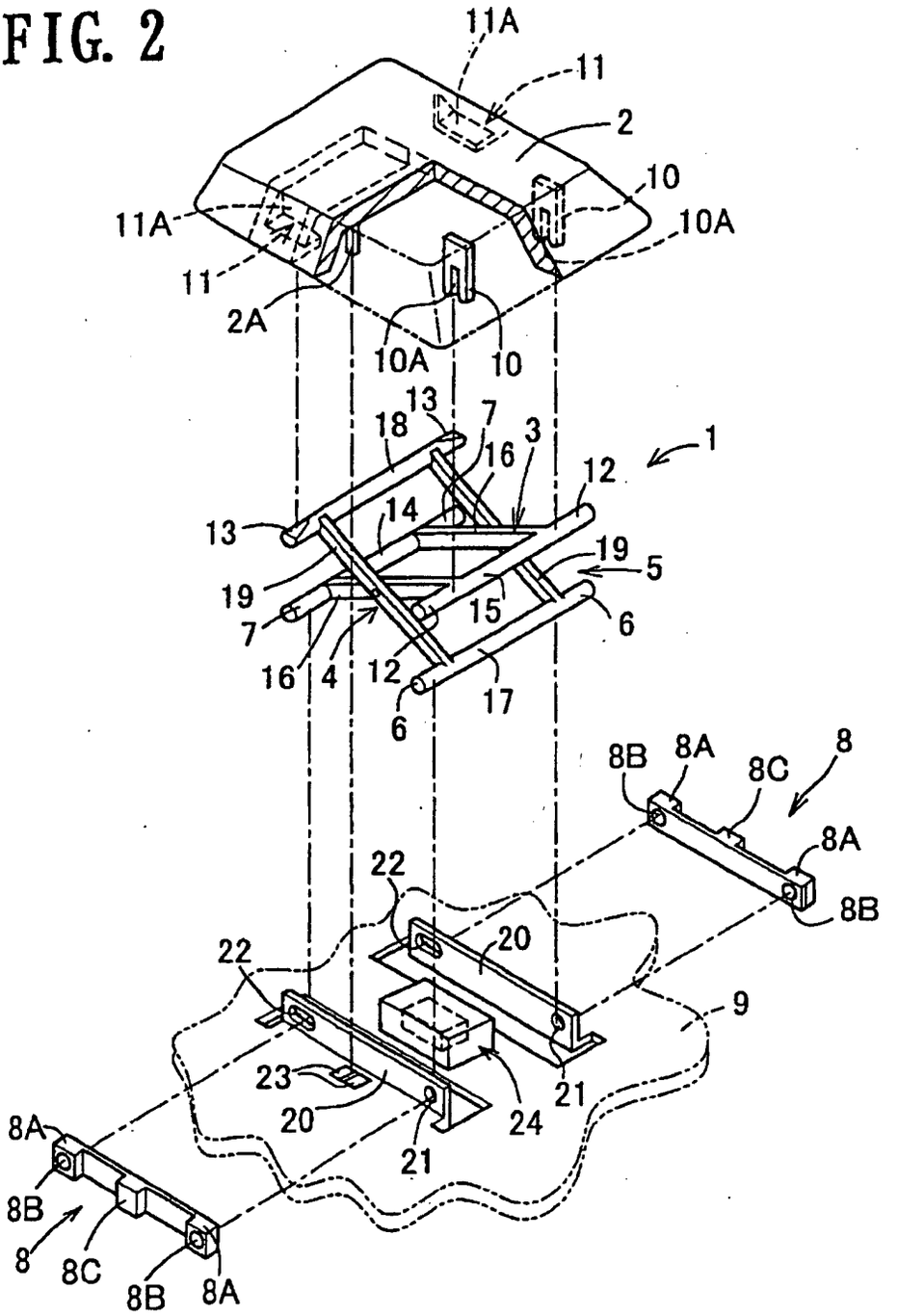

101
106
107
CPU
ROM
RAM
108
109
INPUT/OUTPUT INTERFACE
105
103
110
KEYBOARD
DISPLAY
HD

FIG. 1B

FIG. 2


11A
11
2
10
10A
11A
11
2A
10A
10
13
18
7
3
16
12
1
14
13
19
5
19
15
7
6
16
4
12
17
6
8B
8A
8C
8
8A
8B
22
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24
21
8A
8B
8
8C
8B
8A

FIG. 3

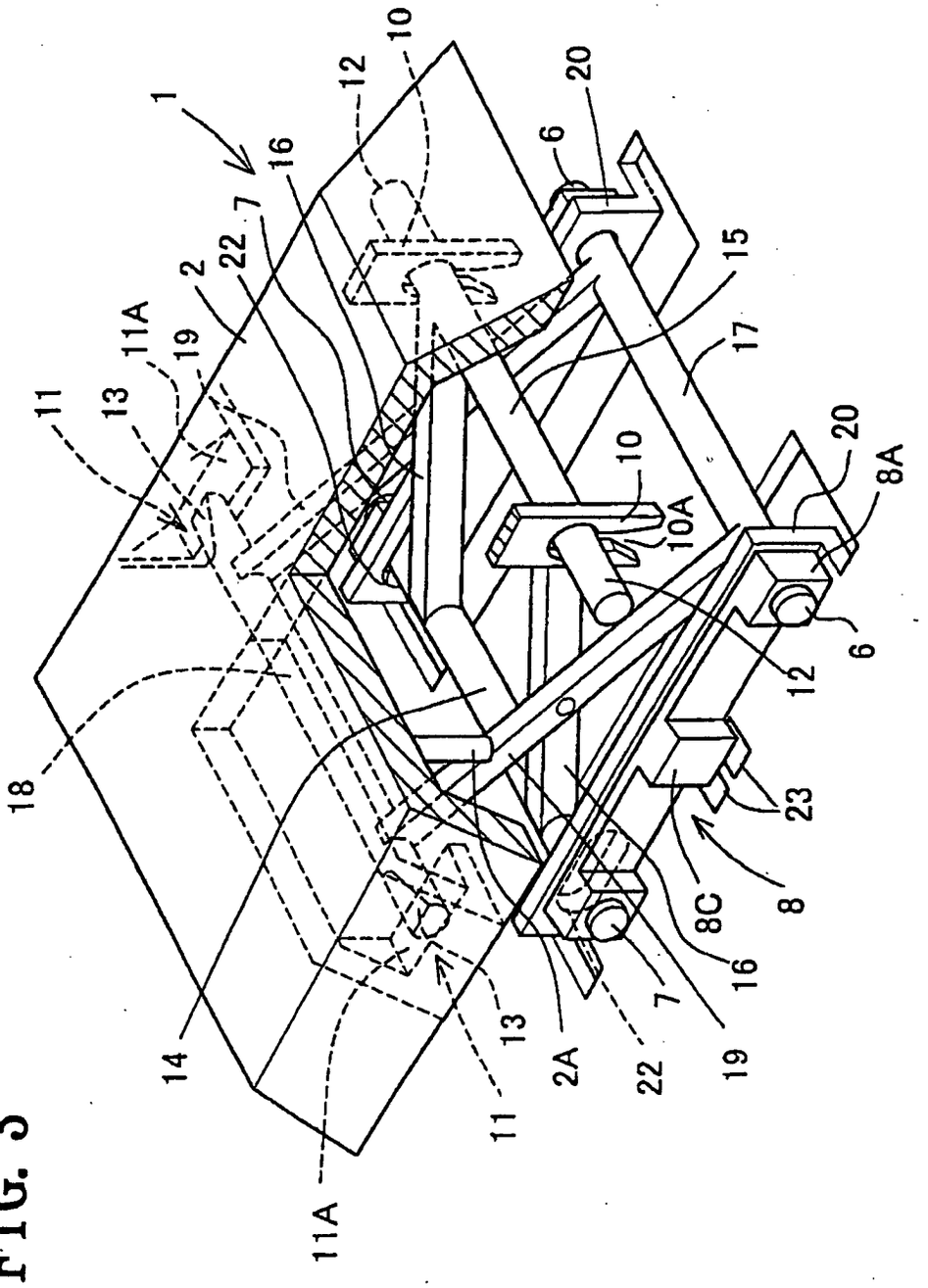


FIG. 4A

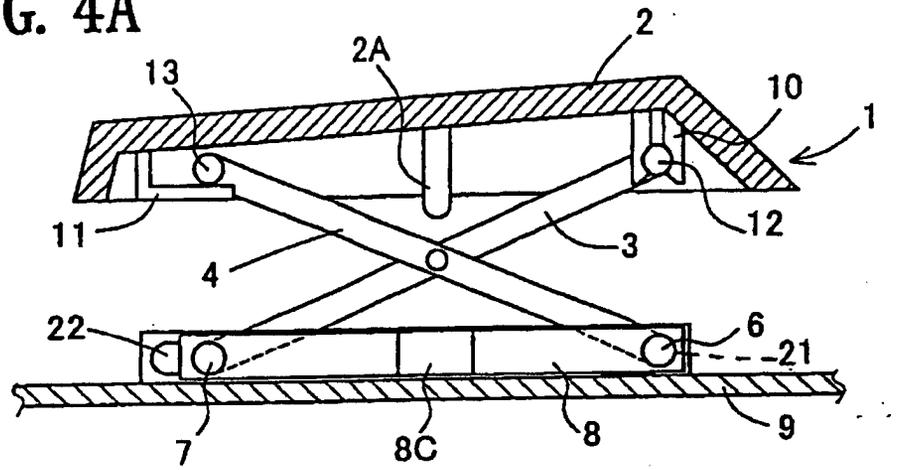


FIG. 4B

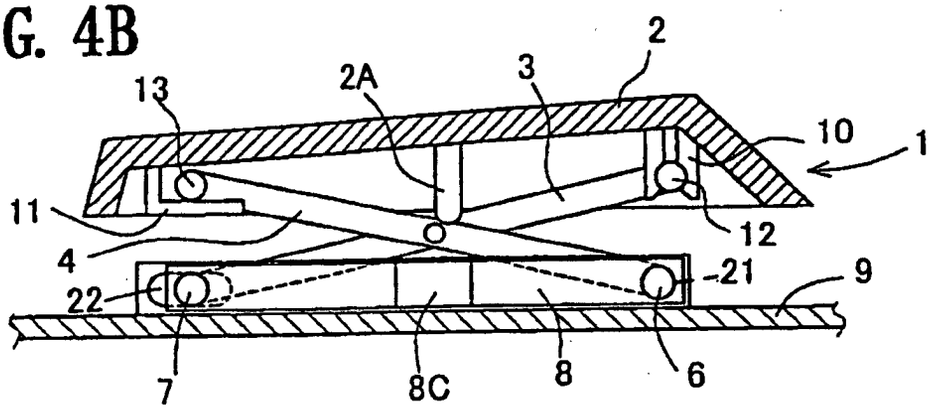


FIG. 4C

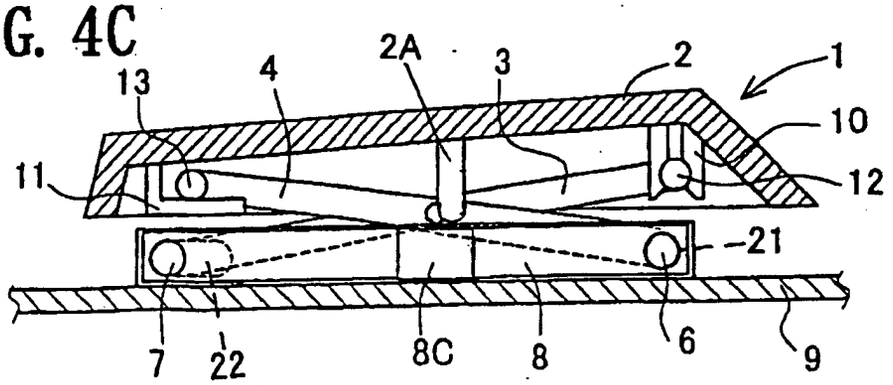


FIG. 5A

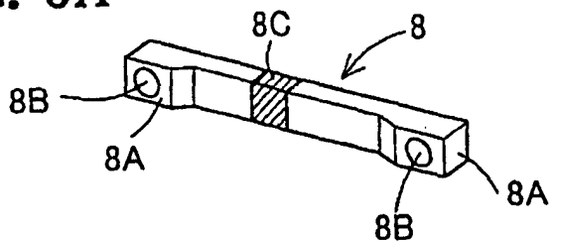


FIG. 5B

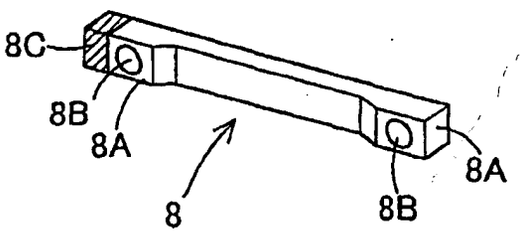


FIG. 6

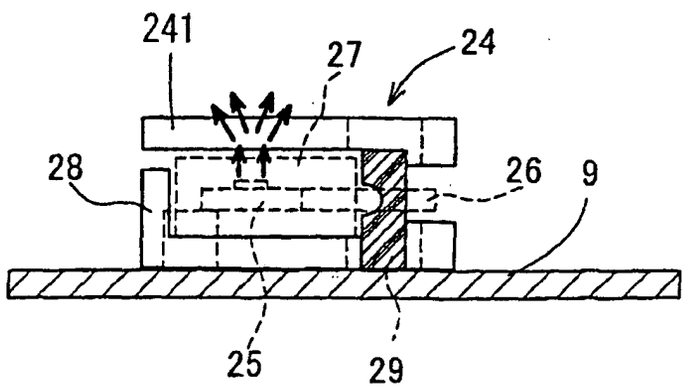
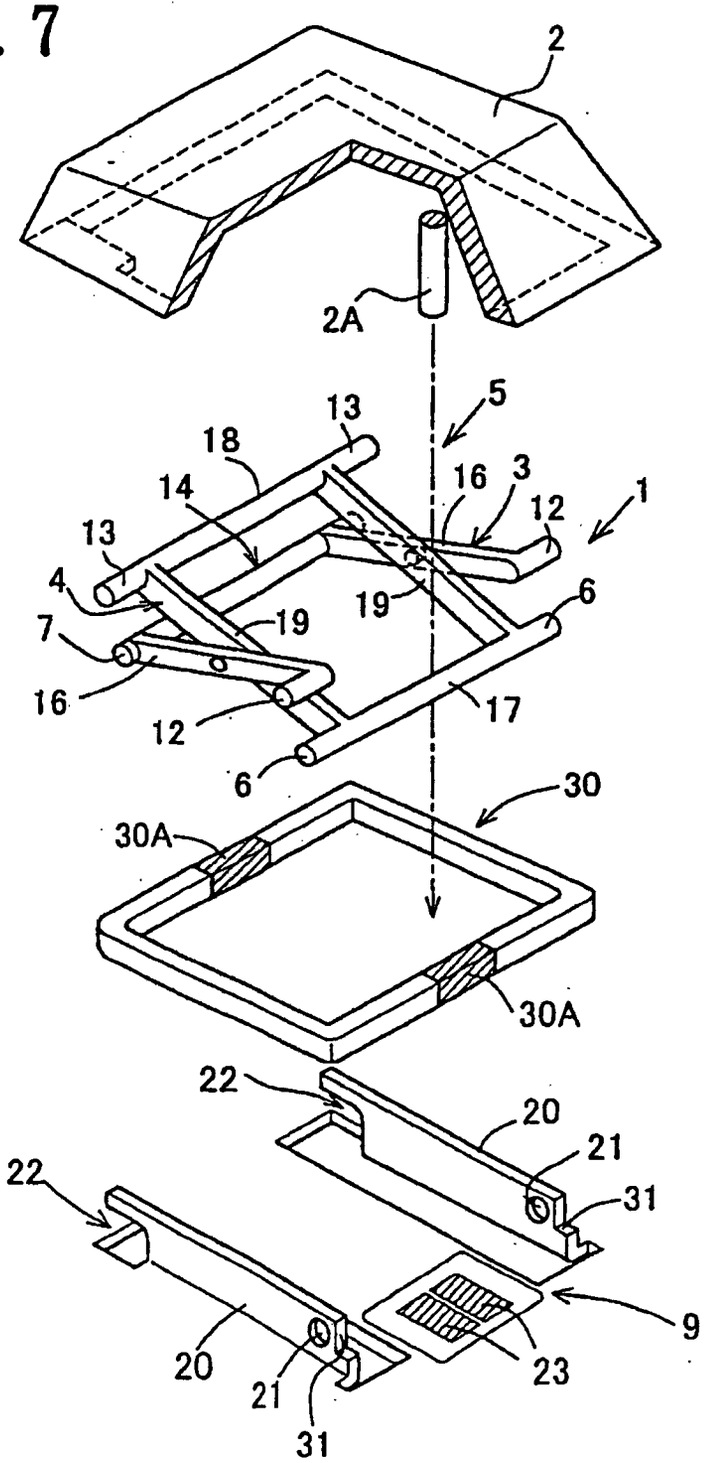


FIG. 7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2A
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13
18
14
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1
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19
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30A
30A
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20
21
31
22
9
20
21
23
31

FIG. 8

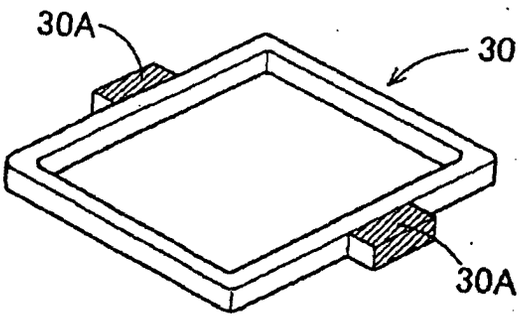


FIG. 9A

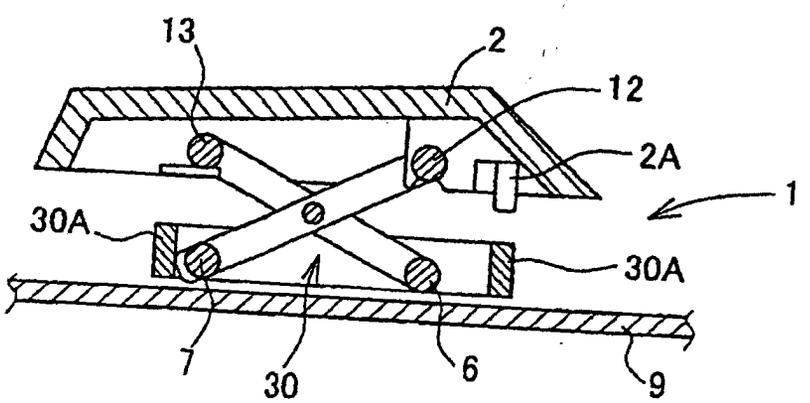


FIG. 9B

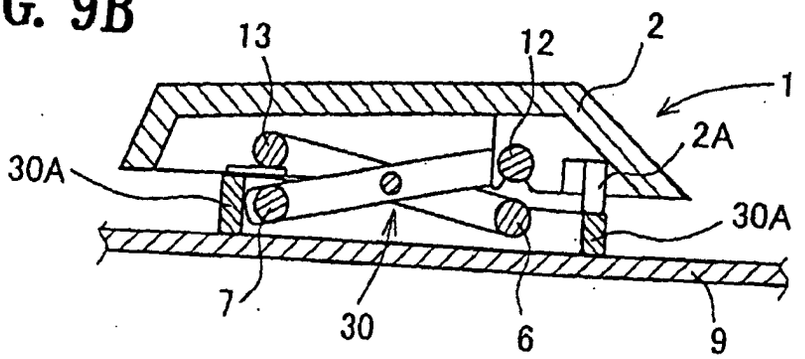
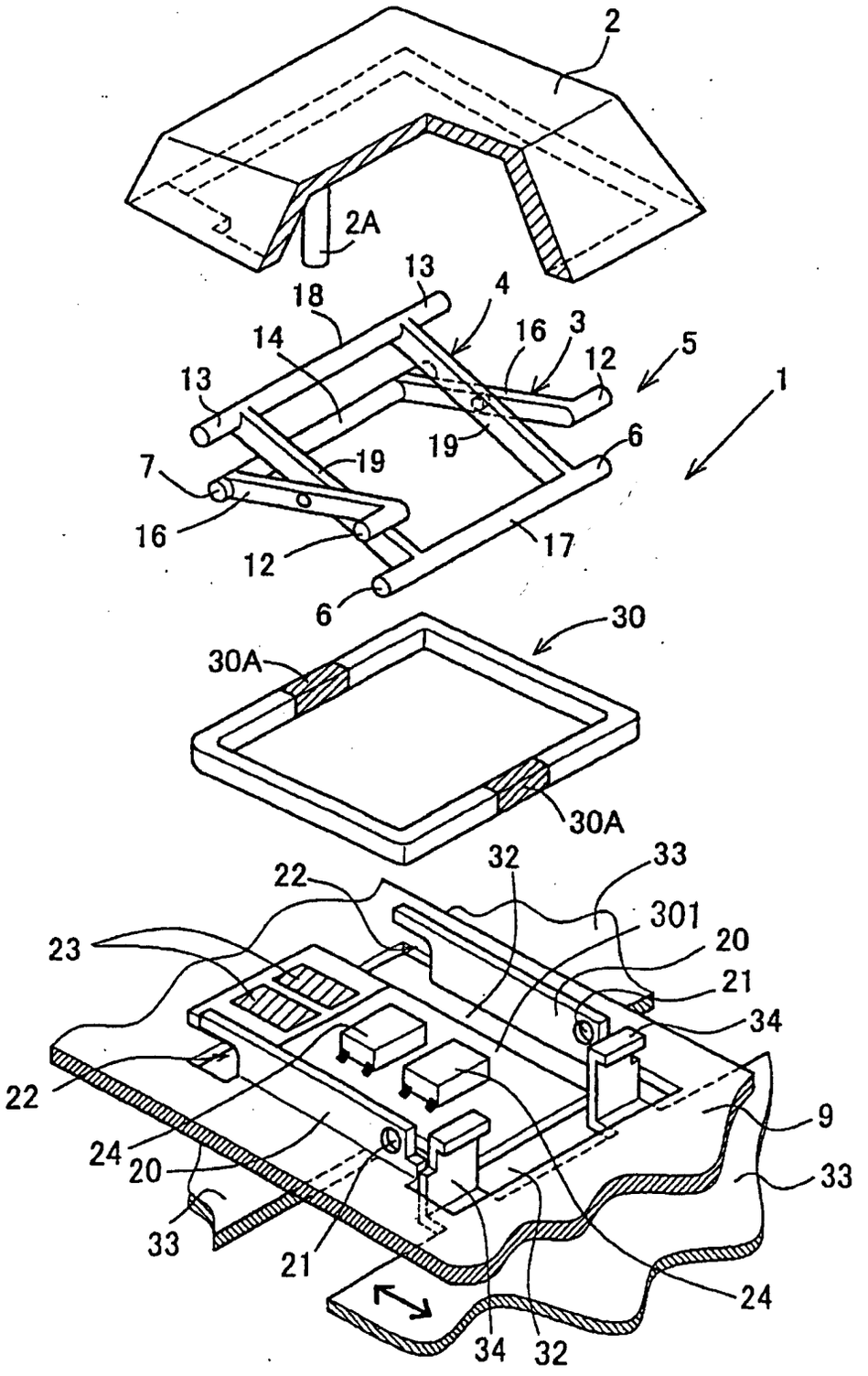


FIG. 10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2A
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7
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30
30A
30A
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32
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301
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21
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34
32

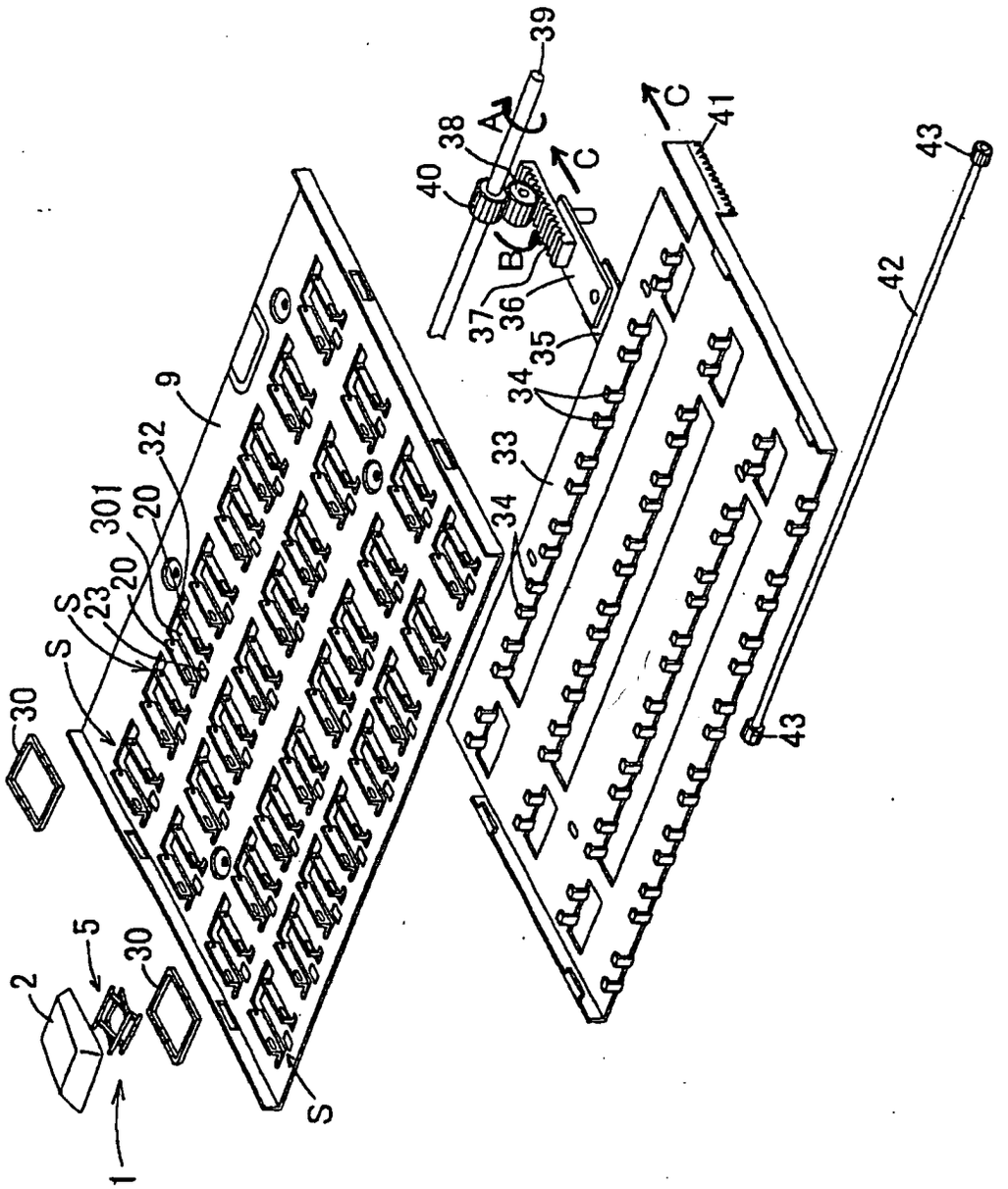

39
38
A
C
40
C
41
43
B
42
37
36
35
34
34
33
9
32
301
20
20
23
S
S
S
30
30
5
2
1
S
43

FIG. 11

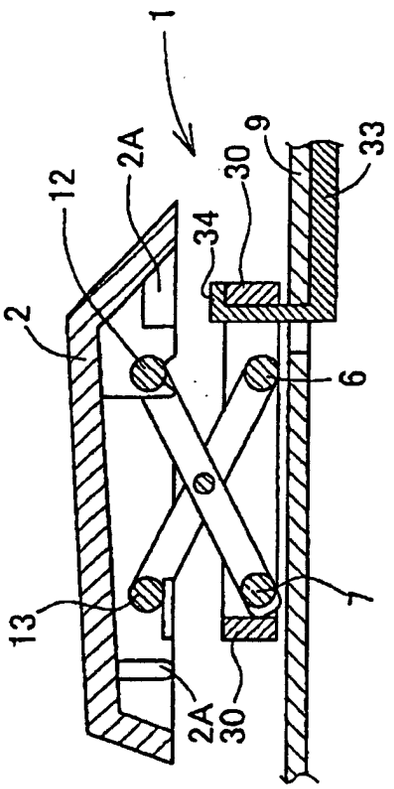


FIG. 12A

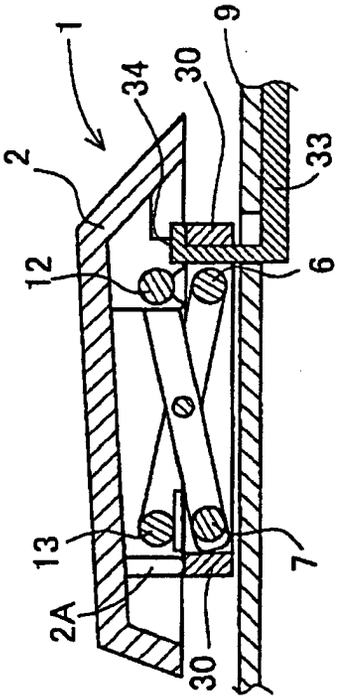


FIG. 12B

FIG. 13A

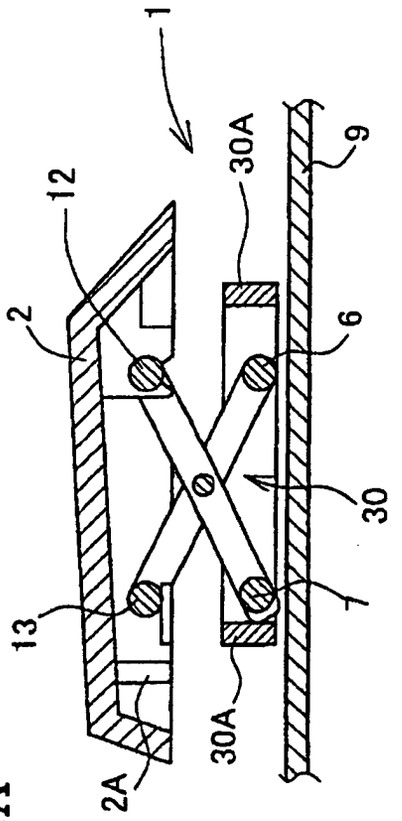
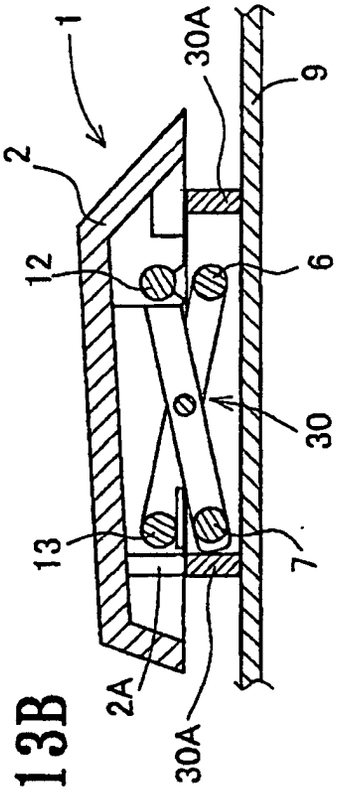


FIG. 13B



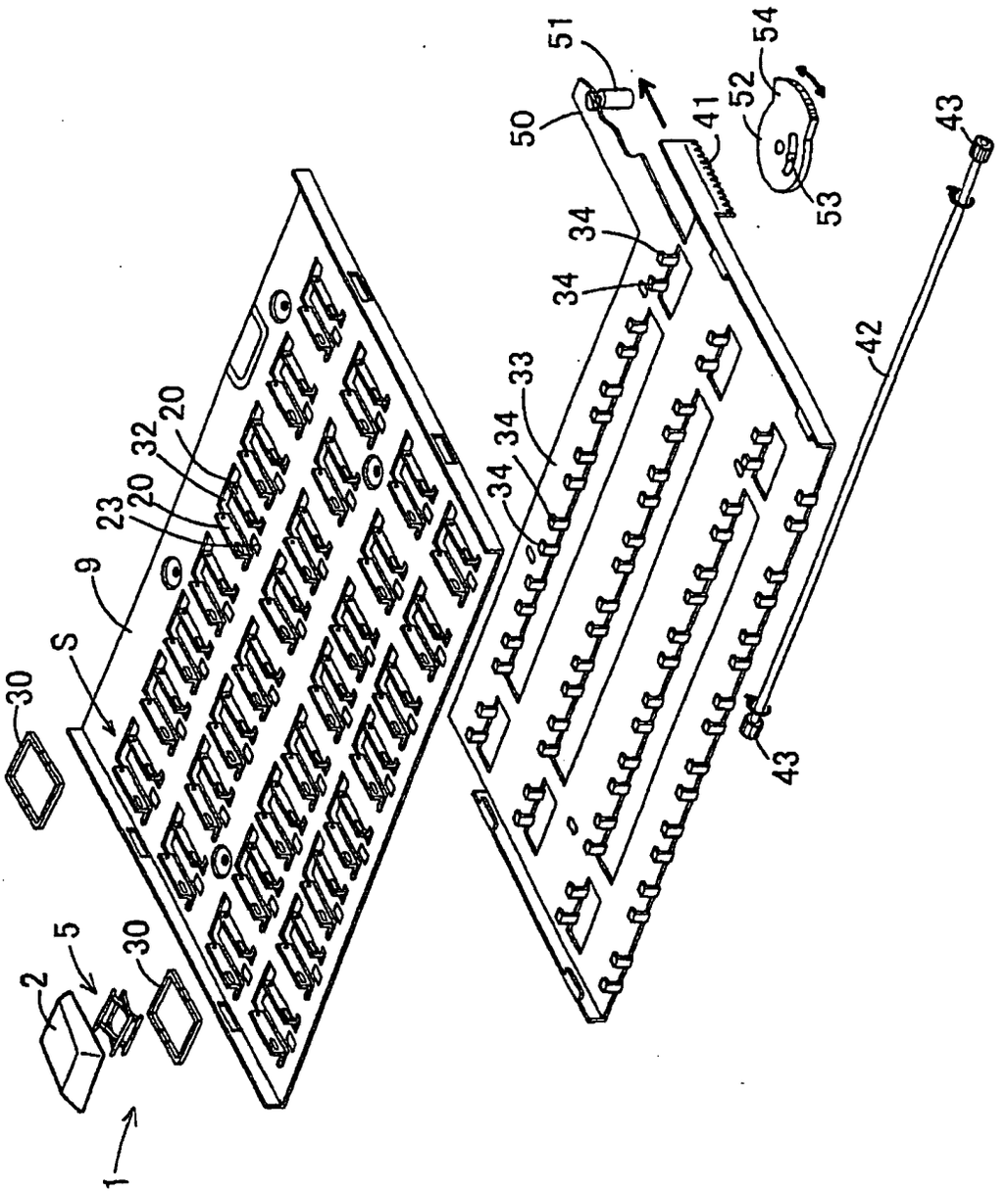


FIG. 14